

## REMARKS

This is intended as a full and complete response to the Final Office Action dated January 29, 2003, having a shortened statutory period for response extended two months to expire on June 30, 2003. Please reconsider the claims pending in the application for reasons discussed below.

In the Advisory Action dated May 15, 2003, the Examiner stated that amendments to claims 8-12 and 15 would not be entered because the amendments raised new issues, requiring further search and consideration. Please reconsider the claims on grounds that Applicant has now placed the application in condition for allowance, without raising new issues.

Claims 8-12 and 15 will remain pending in this application, following cancellation of claims 1-4 and 7 herein. Claims 8-12 and 15 were considered and stand rejected. The claims are amended to correct matters of form. Applicants believe that no new matter has been introduced in this response.

Claim 3 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *Shang, et al.* (U.S. 5,788,778), in view of *Nicolas, et al.* (U.S. 5,284,605), and in further view of *Karwacki, et al.* (U.S. 5,569,151). The Examiner asserts it would have been obvious to obtain purified fluorine as per the teaching of *Nicolaw, et al.* and to deliver this fluorine to the processing site of *Shang, et al.*, in the safe container of *Karwacki, et al.*

*Shang, et al.* discloses cleaning a deposition chamber by activating a halogen containing precursor gas, e.g.,  $\text{NF}_3$ , in a remote chamber via a high power source such as microwave energy, and flowing the reactive species into the deposition chamber. *Shang, et al.* teaches a gas supply system connected to the remote chamber via a valve and controller system to supply chlorine, fluorine,  $\text{NF}_3$ ,  $\text{CF}_4$ ,  $\text{SF}_6$ ,  $\text{C}_2\text{F}_6$ ,  $\text{CCl}_4$ , or  $\text{C}_2\text{Cl}_6$ .

*Nicolas, et al.* discloses obtaining a mixture of fluorine gas and hydrogen gas from the electrolysis of anhydrous hydrofluoric acid and refrigerating the resulting gas at a temperature sufficient to condense hydrofluoric acid in liquid form to separate fluorine gas and other non-condensable gases, such as hydrogen, oxygen and nitrogen, from liquid condensed hydrofluoric acid. *Nicolas, et al.*, further discloses that after separation, the fluorine gas and other non-condensable gases are discharged to be

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reused in combustion or treated to remove fluorine as potassium fluoride or calcium fluoride.

*Karwacki, et al.* discloses a vessel for handling and transporting dangerous gases that utilizes an outer containment vessel, which holds an inner containment vessel containing the gas. In one embodiment, *Karwacki, et al.* discloses the delivery and handling of fluorine gas to be used in an excimer laser.

The Examiner asserts with regard to the specific limitation of claim 8, which is concerned with "generating a fluorine cleaning gas on site with but remote to the process chamber, that it is obvious to "generate or obtain the cleaning gas from the source, which is located as close as possible to the subject to be cleaned in order to cut down or eliminate additional expenses related to transportation and distribution of hazardous gaseous materials, such as fluorine gas. Applicants submit it is not obvious to generate a fluorine cleaning gas from hydrofluoric acid on site by combining the teachings of *Shang, et al.*, *Nicolas, et al.*, and *Karwacki, et al.*

*Shang, et al.* could not use hydrofluoric acid as a starting material within the metes and bounds of the invention taught therein. Hydrofluoric acid is considered a non-cleaning gas even though fluorine radicals can be generated with the application of energy because the fluorine radicals would recombine with the hydrogen radicals before any cleaning could be accomplished. As such, no motivation is found to generate on-site a cleaning gas from hydrofluoric acid.

Furthermore, *Nicolas, et al.* does not generate a mixture consisting essentially of hydrofluoric acid and fluorine gas as recited in claim 8 since the gas mixture in *Nicolas, et al.* contains other non-condensable gases, such as hydrogen, nitrogen, and oxygen. In the present invention, hydrogen gas is removed through an exhaust system during electrolysis, leaving a mixture of hydrofluoric acid and fluorine gas.

Therefore, *Shang, et al.*, *Nicolas, et al.*, and *Karwacki, et al.*, alone or in combination do not teach, show or suggest generating a fluorine cleaning gas from hydrofluoric acid, said fluorine cleaning gas generated on-site with but remote to the process chamber, said generating comprising converting said hydrofluoric acid to a gas mixture consisting essentially of said hydrofluoric acid and said fluorine gas, transferring the gas mixture to a cold trap; converting said hydrofluoric acid in said gas mixture into

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a liquid hydrofluoric gas; and removing said liquid hydrofluoric acid from the cold trap, said fluorine cleaning gas remaining in a gaseous form, and activating said fluorine cleaning gas to form fluorine radicals; and cleaning the process chamber with said fluorine radicals, as recited in claim 8. Applicants respectfully request withdrawal of the rejection.

Claims 9-12 and 15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Shang, et al.* (U.S. 5,788,778), in view of *Nicolas, et al.* (U.S. 5,284,605), and in further view of *Karwacki, et al.* (U.S. 5,569,151). Claims 9-12 and 15 are dependent from claim 8 and are therefore patentable for the same reason. Applicants respectfully request withdrawal of the rejection.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the method or apparatus of the present invention. Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

The prior art made of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, it is believed that a detailed discussion of the secondary references is not deemed necessary for a full and complete response to this office action. Accordingly, allowance of the claims is respectfully requested.

Respectfully submitted,



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Keith M. Tackett  
Registration No. 32,008  
MOSER, PATTERSON & SHERIDAN, L.L.P.  
3040 Post Oak Blvd., Suite 1500  
Houston, TX 77056  
Telephone: (713) 623-4844  
Facsimile: (713) 623-4846  
Attorney for Applicant(s)

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**VERSION WITH MARKINGS TO SHOW CHANGES MADE****IN THE CLAIMS:**

8. (Amended) A method for cleaning a process chamber for semiconductor and/or flat panel display manufacturing, comprising [the steps of]:

generating a fluorine cleaning gas from hydrofluoric acid, said fluorine cleaning gas generated on-site with but remote to the process chamber, said generating [step] comprising:

converting said hydrofluoric acid to a gas mixture consisting essentially of said hydrofluoric acid and said fluorine gas;

transferring the gas mixture to a cold trap;

converting said hydrofluoric acid in said gas mixture into a liquid hydrofluoric gas; and

removing said liquid hydrofluoric acid from the cold trap, said fluorine cleaning gas remaining in a gaseous form; [and]

activating said fluorine cleaning gas to form fluorine radicals [to clean the process chamber]; and

cleaning the process chamber with said fluorine radicals.

9. (Amended) The method of claim 8, wherein said fluorine cleaning gas is pumped into a storage unit prior to said activating [step] said fluorine cleaning gas.

15. (Amended) The method of claim [14] 8, wherein said converting said hydrofluoric acid is via electrolysis.

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